## Space Weather Technical Forecast

Issued on Thursday 13 March 2025 at 01:02 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of isolated M-class flares. G1 likely, Chance of G2 days 1, 2 and 4.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Low, with multiple C-flares during the past 24hrs. There are currently eleven regions on the Earth-facing disc. The main region of interest continues to be AR4019 in the northeast, which has seen some development in its intermediate region but some weakening in its trailer, maintaining a weak delta spot in its compact central portion. AR4021 in the southeast also appears to have a delta within the main central spot. A new region has rotated around the southeast limb, which is difficult to assess due to foreshortening, but has been the likely source of numerous flares in the past day or so. The remaining spots have shown minor changes and most are small or stable at present.

No Earth-directed CMEs have been observed.

**Solar Wind / Geomagnetic Activity:** Solar winds, as measured by ACE at L1, showed a likely connection to CH22/-. Wind speeds were initially slow-ambient, near 390 km/s before erratically rising to elevated, ending near 550 km/s. Density was mostly below average. The Interplanetary Magnetic Field, Bt, has been mostly moderate between 7-12nT. The north-south component, Bz, was mostly moderately negative, ranging from +11 to -11nT. Phi angle was negative (towards the Sun). Geomagnetic activity was Unsettled (Kp3) to G1/Minor Storm (Kp5).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV) at GOES18 was near background levels. High energy electron flux (greater than 2 MeV) reached high levels at the diurnal max, recording a max of 1990 at 12/1550UTC. The 24-hour fluence started above the Active threshold (1e8 integrated pfu) from 11/1200 UTC, but has since fallen to below the Active threshold since 12/1800UTC, with 5.33e7 integrated pfu observed at 13/0000 UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Low to Moderate activity is most likely, with a chance of isolated M-class flares.

**Solar Wind / Geomagnetic Activity:** No CMEs feature in the forecast. Solar winds have once again become elevated due to the likely arrival of CH22/- during the afternoon of 12 Mar. Solar wind speeds are expected to become Strong, around 600 km/s or a little faster, lasting through day 1 into day 2 (13 & 14 Mar) before easing later day 2 or into day 3 (15 Mar). Solar winds should

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then ease back to slightly elevated levels days 3 and early day 4 (15 and 16 Mar) before once again becoming elevated to strong later day 4 upon the connection to CH23/-.

Geomagnetic activity is expected to be mainly Unsettled to Active with periods of G1/Minor and a chance of G2/Moderate geomagnetic storms through days 1 and 2 (13/14 Mar). Geomagnetic activity is expected to become Quiet to Unsettled day 3 and early day 4 (15/16 Mar) before the risk of G1-G2/Minor-Moderate geomagnetic storms returns later day 4.

**Energetic Particles / Solar Radiation:** High energy proton flux is most likely to remain close to background levels. High energy electron flux is now supressed but still may reach high levels at the diurnal peaks. The associated 24 hour fluence is expected to stay below Active, potentially rising above by day 4 (16 Mar).

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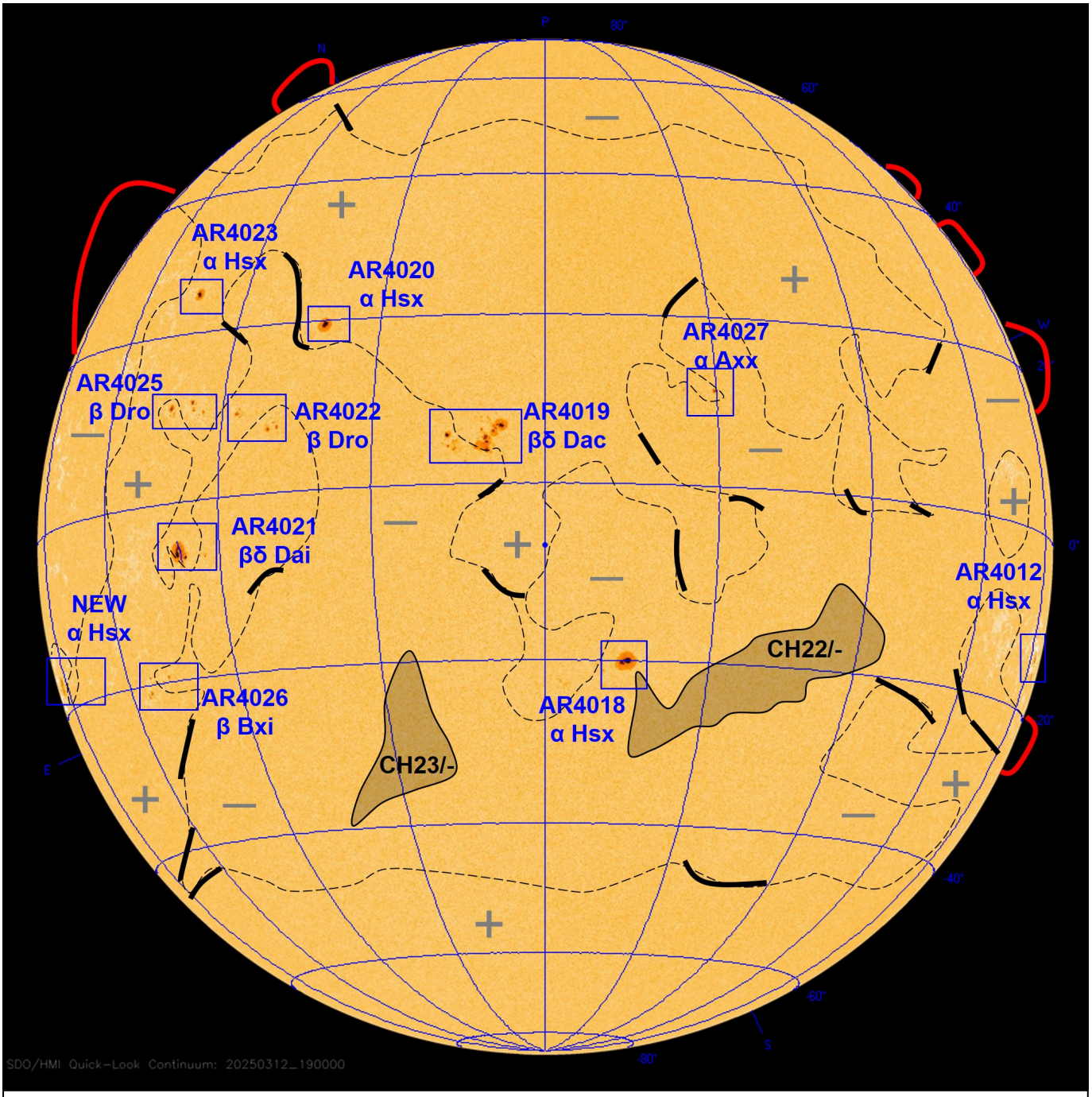
**Figure 1: Solar Synoptic Map valid 12/1900UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms

No CMEs feature in the forecast.

Solar winds have once again become elevated due to the likely arrival of CH22/- during the afternoon of 12 Mar. Solar wind speeds are expected to become Strong, around 600 km/s or a little faster, lasting through day 1 into day 2 (13 & 14 Mar) before easing later day 2 or into day 3 (15 Mar). On the previous rotation, there was no gap in the large southern coronal hole. On this rotation, a gap has formed, with two separately numbered coronal holes (22 and 23) both of which are negative. MOSWOC Enlil is likely struggling to capture and represent this gap, therefore on this rotation we are expecting solar winds to ease back to slightly elevated levels days 3 and early day 4 (15 and 16 Mar) before once again becoming elevated to strong later day 4 upon the connection to CH23/-.

Geomagnetic activity is expected to be mainly Unsettled to Active with periods of G1/Minor and a chance of G2/Moderate geomagnetic storms through days 1 and 2 (13/14 Mar). Geomagnetic activity is expected to become Quiet to Unsettled day 3 and early day 4 (15/16 Mar) before the risk of G1-G2/Minor-Moderate geomagnetic storms returns later day 4.

| Geomagnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Minor or Moderate** | **G1 to G2** | No | 60 | 60 | 20 | 60 |
| **Strong** | **G3** | No | 10 | 10 | 1 | 5 |
| **Severe** | **G4** | No | 1 | 1 | 1 | 1 |
| **Extreme** | **G5** | No | 1 | 1 | 1 | 1 |

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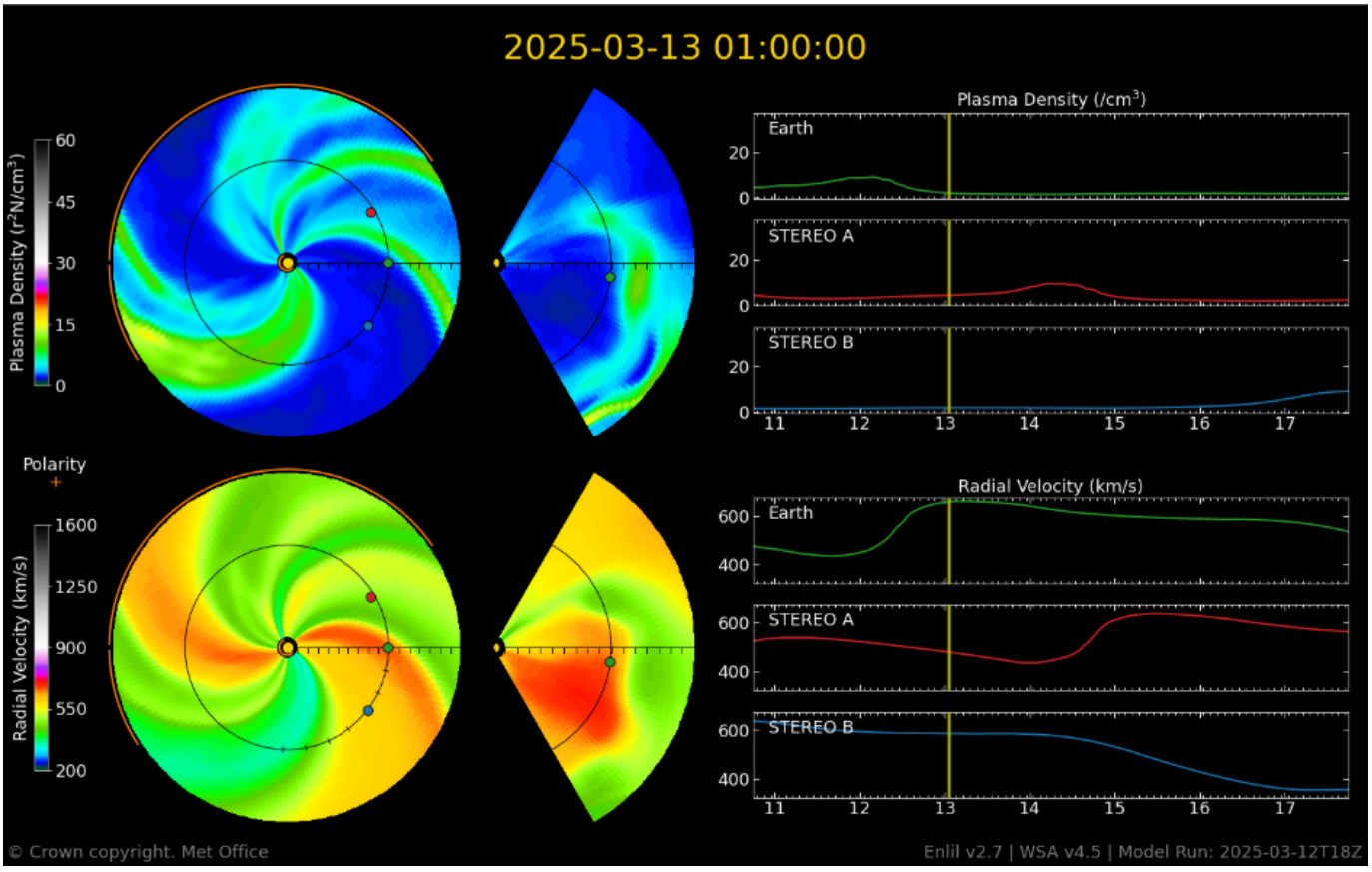
**Figure 2: MOSWOC ENLIL**



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## Radio Blackouts - X-Ray Flares

Solar activity has been Low, with multiple C-flares during the past 24hrs, these mostly from either AR4024 in the northwest, or from beyond the southeast limb.

There are currently eleven regions on the Earth-facing disc. The main region of interest continues to be AR4019 in the northeast, which has seen some development in its intermediate region but some weakening in its trailer, maintaining a weak delta spot in its compact central portion. AR4021 in the southeast appears to have a delta within the main central spot. AR4018 in the south has lost it's trailing portion. AR4024 in the northwest has faded to plage. A new region has rotated around the southeast limb, which is difficult to assess due to foreshortening, but has been the likely source of numerous flares in the past day or so. The remaining spots have shown minor changes and most are small or stable at present.

There are several ex-sunspot regions which may return over the east limb during this period, with some looping showing in SDO imagery to support this. However, the potential activity levels of any new regions cannot be assessed until they appear on the visible disc. Low to Moderate activity is most likely, with a slightly increasing chance of isolated M-class flares, with perhaps the most likely flare source now looking to be near the SE limb.

| X-Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 (M Class) | No | 40 | 45 | 50 | 50 |
| Very Active | R3-R5 (X Class) | No | 5 | 5 | 5 | 5 |

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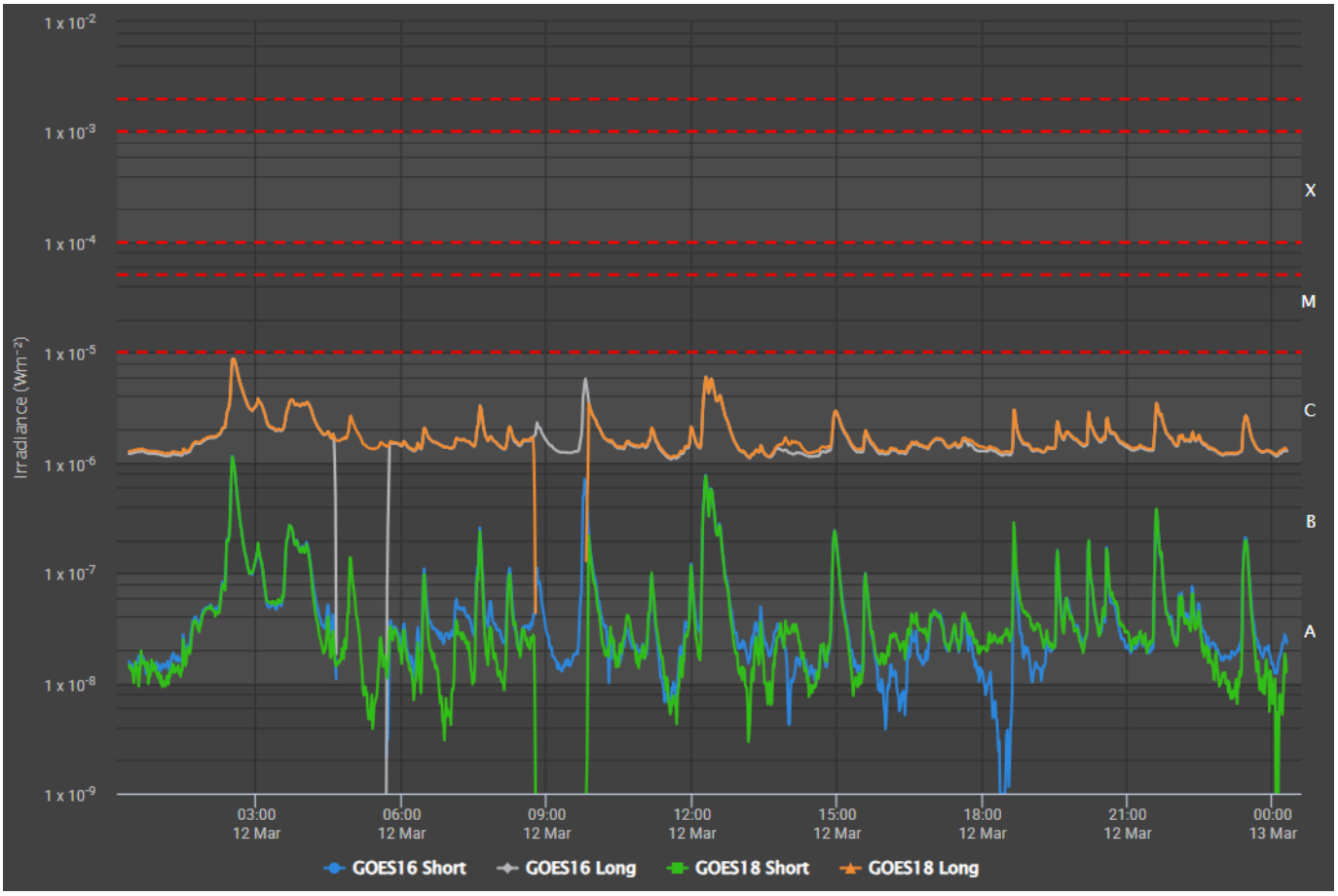
**Figure 3: 24 hour X-ray trace.**

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## Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux has been near background, with this expected to persist, with the current regions bringing a low risk of producing proton enhancements. That said, the majority of the sunspot regions are in the east of the visible disc and there is a very slightly increasing risk as these regions rotate westward into a better connected position with respect to Earth later in the period.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}sr^{-1}s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 5 | 5 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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## High Energy Electrons (≥ 2MeV)

The high-energy electron flux (>2MeV) observed at GOES16 has been reaching diurnally high levels in previous days, though have now become suppressed due to the connection to the fats wind of CH22/- supressing the Van Allen belts. This is expected to continue through days 1 and 2 (13 and 14 Mar), though perhaps becoming briefly diurnally high once again days 3 and 4 (15/16 Mar) before the HSS from CH23/- arrives later day 4.

The 24 hour integrated fluence is currently below Active (1e8 integrated pfu) threshold, and on a downward trend. The next possible period of rising to above Active is day 4 as Earth enters the gap between two coronal holes, though confidence for this remains low. MOSWOC REFM is considered to be giving a reasonable guidance, although perhaps underplaying the risk during day 4 (16 March) due to the southern coronal hole being one long feature on the previous rotation.

| GEO Electron Environment | Level ($cm^{-2}sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1\times10^{8}$ | Yes | 10 | 10 | 20 | 40 |
| Very Active | ≥ 2 MeV ≥ $1\times10^{9}$ | No | 1 | 1 | 1 | 1 |

**Figure 4: MOSWOC REFM Fluence forecast/recurrence/observations.**

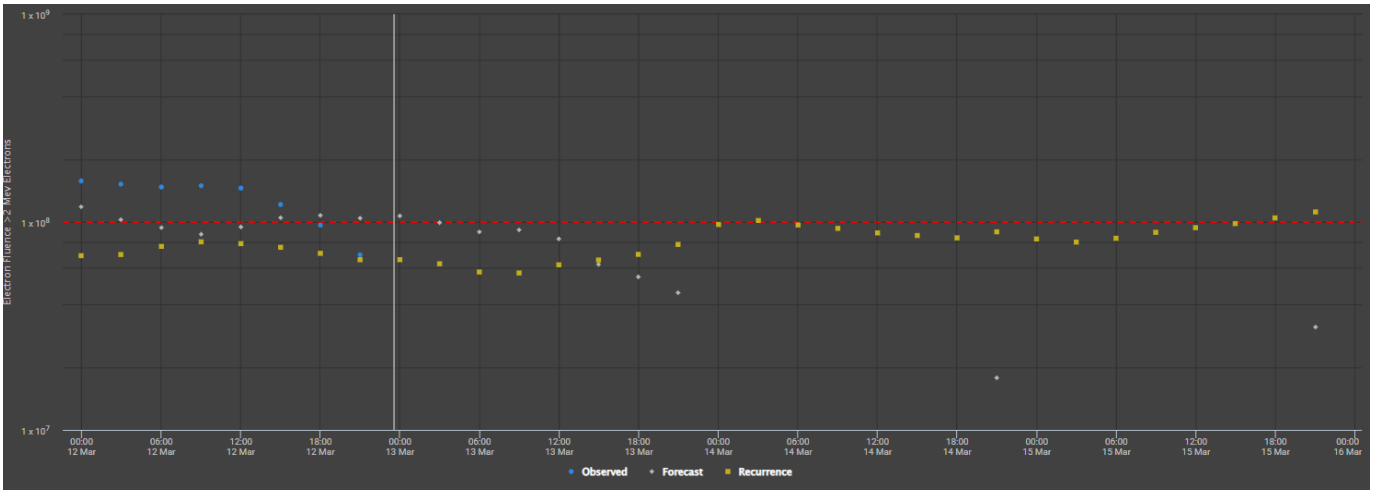


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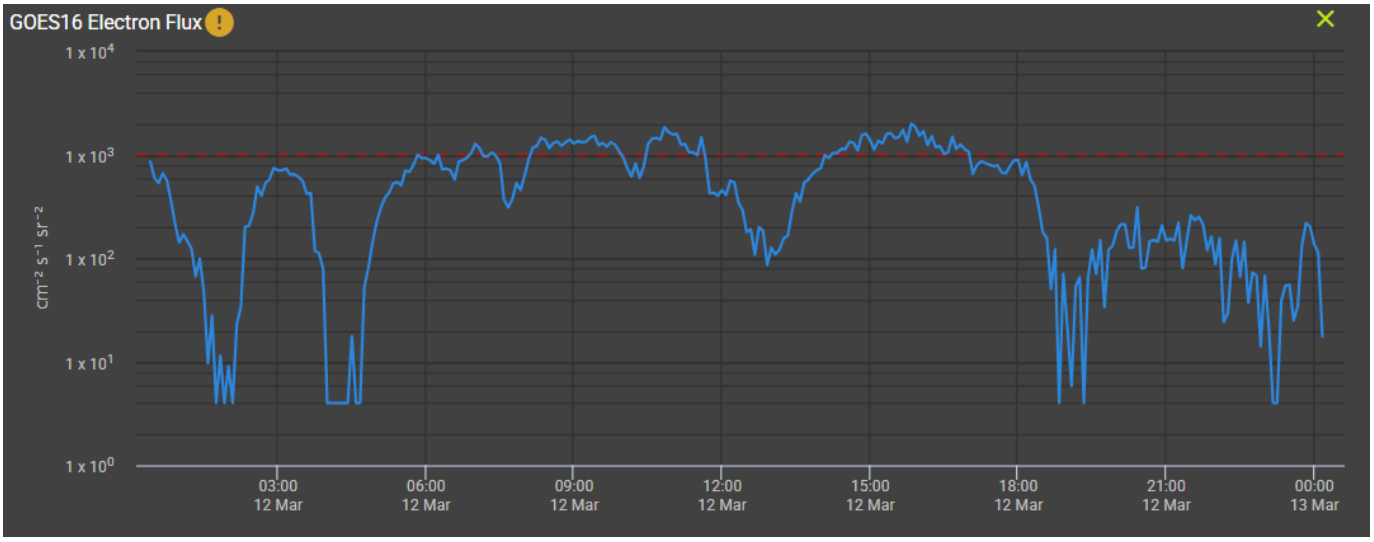
**Figure 5: 24 hour electron flux trace.**



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